We claim:

1. An arrayed waveguide grating (AWG) disposed on a substrate, comprising:

an input slab with a plurality of inputs and a plurality of outputs,

an output slab with a plurality of inputs and a plurality of outputs and

a plurality of waveguides coupled between the input slab and the output slab, where each of the plurality of waveguides:

has a phase modulator in the optical path, and

has a predetermined optical path length difference with respect to an adjacent waveguide, and

where each phase modulator has an input for receiving a control signal, and the phase modulator modifies the phase of light propagating through it in response to the received control signal.

2. An AWG according to claim 1, wherein there are at least three waveguides coupled between the input slab and the output slab.

3. An AWG according to claim 1, and further comprising:

a controller with a first plurality of outputs,

where each of the first plurality of outputs is coupled to the control signal input of a respective one of the plurality of phase modulators

4. An AWG according to claim 3, and further comprising a memory system coupled to the controller.

5. An AWG according to claim 4, and further comprising:

a plurality of photodetectors,
and
a first plurality of inputs to the controller,
where each of the plurality of photodetectors has an optical input and an electrical output,
each optical input of the plurality of photodetectors is coupled to a respective one of the plurality of outputs of the output slab,
each of the plurality of photodetectors generates an electrical signal at a respective output in response to detected light and
each output of the plurality of photodetectors is coupled to a respective one of the plurality of inputs to the controller.

6. An AWG according to claim 5, wherein the AWG, the controller, the memory and the plurality of photodetectors are disposed on a substrate.

7. An AWG according to claim 5, and further comprising:
a plurality of temperature sensors, where each of the plurality of temperature sensors has an output and each temperature sensor is in substantial thermal proximity to the AWG,
and

a second plurality of inputs to the controller, where each of the second plurality of inputs is coupled to a respective one of the plurality of temperature sensors.

8. An AWG according to claim 7, and further comprising:
a plurality of heating elements, where each of the plurality of heating elements has an input and each of the plurality of heating elements is in substantial thermal proximity to the AWG,
and
a second plurality of outputs from the controller, where each of the second plurality of outputs is coupled to a respective one of the plurality of heating elements.

9. An AWG according to claim 8, wherein the AWG, the controller, the memory system, the plurality of photodetectors, the plurality of temperature sensors and the plurality of heating elements are disposed on a substrate.

10. An AWG according to claim 1, wherein each of the plurality of waveguides has at least one curved section, where the at least one curved section is substantially identical to a curved section in an adjacent waveguide of the AWG.

11. An AWG according to claim 1, wherein the phase modulator is selected from one of the following: a transistor, a PIN diode and a resistor.

12. An AWG according to claim 1, wherein at least one of the plurality of waveguides is selected from a group comprising: a strip loaded waveguide, a channel waveguide, a rib waveguide and a ridge waveguide.

13. The optical apparatus according to claim 12, wherein the strip loaded waveguide comprises a strip, a slab and a low index transition layer between the strip and the slab.

14. An AWG according to claim 1, wherein the substrate is selected from the group comprising: silicon, silicon on insulator (SOI), silicon on sapphire (SOS), silicon on nothing (SON) and

a first layer of monocrystalline silicon,
a second layer of dielectric material disposed on the first layer,
a third layer of monocrystalline silicon disposed on the second layer,
a fourth layer of dielectric material disposed on the third layer,
a fifth layer of monocrystalline silicon disposed on the fourth layer.

15. A system for phase error compensation of an AWG comprising:

a plurality of phase modulators, where each phase modulator has an input,

a controller, where the controller has a plurality of inputs and a plurality of outputs, and each of the plurality of outputs is coupled to an input of a respective one of the plurality of phase modulators,

and

a plurality of photodetectors, where each of the photodetectors is optically coupled to a respective one of a plurality of outputs of the AWG, and each of the photodetectors has an output coupled to a respective input of the controller.

16. A system for phase error compensation of an AWG comprising:

a plurality of phase modulators, where each phase modulator has an input and each phase modulator is in an optical path of a respective one of a plurality of arrayed waveguides of the AWG,

a controller with an output, an input and a plurality of outputs,

a signal generator with an input and an output,

a light source of a selected frequency,

a modulator with an optical input, an optical output and a signal input,

a photodetector with an optical input and an electrical output, and

a signal detector with an input and an output,

where:

the output of the controller is coupled to the input of the signal generator,

the output of the signal generator is coupled to the signal input of the modulator,

the input of the modulator is coupled to the light source,

the output of the modulator is coupled to a selected one of a plurality of inputs to the AWG,

the input of the photodetector is coupled to a selected one of a plurality of outputs of the AWG,

the output of the photodetector is coupled to the input of the signal detector,

the output of the signal detector is coupled to the input of the controller, and

each of the plurality of outputs of the controller is coupled to a respective one of the plurality of phase modulators.

17. A method for adjusting the phase modulation of light propagating through an optical path of a selected waveguide of an arrayed waveguide grating (AWG), where the selected waveguide includes a phase modulator in the optical path, comprising:

coupling a selected frequency of light to a selected input to the AWG,

measuring the power output level of light received at a selected output of the AWG,

and

maximizing the power output level of light at the selected output of the AWG, by adjusting the amount of phase modulation in the selected

waveguide by sending a control signal to the phase modulator in the selected waveguide.

18. The method of claim 17, further including storing the adjustment to the phase modulator in a memory system.

19. The method of claim 17, further including maintaining the AWG at a selected temperature.

20. The method of claim 17, further comprising modulating the selected frequency of light coupled to the selected channel of the AWG.

21. A method for adjusting the phase modulation of light propagating through an optical path of a selected channel of an AWG, where each of an array of waveguides in the AWG includes a phase modulator in the optical path, comprising the steps of:

coupling a selected frequency of light to the selected channel of the AWG,

measuring the power output level of light received from the selected channel of the AWG,
and
maximizing the power output level of light received from the selected channel of the AWG,
by selecting a phase modulator in the optical path of the selected channel
and

adjusting the amount of phase modulation in the optical path of the selected waveguide by sending a control signal to the selected phase modulator.

22. The method of claim 21, further including storing the adjustment to the phase modulator in a memory system.

23. The method of claim 21, further including maintaining the AWG at a selected temperature.

24. The method of claim 21, further comprising modulating the selected frequency of light coupled to the selected channel of the AWG.

25. A method for designing the physical layout of a plurality of arrayed waveguides of an AWG comprising:

designing a curved section of a first waveguide of the plurality of arrayed waveguides to substantially identical to a curved section of a second waveguide adjacent to the first waveguide of the plurality of arrayed waveguides
and
designing each of a plurality of straight sections of each of the plurality of arrayed waveguides by aligning each straight section parallel with the x and y axes generated by integrated circuit layout software, where the x and y axes are the reference axes which determine the placement of integrated circuit electrical pathways parallel to the reference axes.

26. A method for shaping the passband of a selected channel of an AWG, comprising the steps of:

determining a desired shape for the passband of the selected channel,

determining the amount of deviation from the desired shape for the passband of the selected channel,
and
adjusting the shape of the passband of the selected channel by adjusting the phase modulation of at least one of the plurality of waveguides of the AWG.

27. A method for selecting the output port of an AWG for light of a given wavelength, where each of an array of waveguides in the AWG includes one of a plurality of phase modulator in the optical path, comprising:

designing the AWG with a selected center channel wavelength with a designed output channel and channel spacing for a selected temperature range,

sending a control signal to at least one of the plurality of phase modulators to select an adjacent output channel for light of a selected wavelength, where the new output channel is different from the designed output channel.

28. The method of claim 27, where by changing the output port for light of a selected wavelength to an adjacent output port, the output ports for light of other wavelengths are also shifted accordingly.

29. The method of claim 28, where the AWG is designed with a free spectral range that is exactly equal to the number of channels multiplied by the channel spacing.

30. The method of claim 29, where light of a selected wavelength is always routed to one of the outputs of the AWG, further comprising:

monitoring the temperature of the AWG chip

sending a control signal to each of the plurality of phase modulators to shift the entire comb of output port peak wavelengths, where the comb of output port peak wavelengths matches with the comb of signals at the temperature measured,

sending the information regarding which physical channels the desired signals are output on, to the rest of the optical integrated circuit.